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BIODIVERSITY AND CONSERVATION

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ABSTRACT

Whereas a well-maintained herbarium is a safe repository of plant specimens, of extreme utility for research in taxonomy, phytogeography, evolution, conservation and even archaeology, in nature the plant diversity is threatened by several factors, mainly anthropic.

The variety of climatic and soil types available in Peninsular India are briefly reviewed to understand the basis of biodiversity in the region.

The vegetation types provide the basic framework to appreciate the biodiversity. The maps prepared by ICAR-French Institute depicting the "series of vegetation" have been planimetrically analysed to note the potential area under each series, the percentage of it under forest and under degraded vegetation. The forest-cover in Peninsular India comes out only 7 to 8 per cent according to different sources with degraded vegetation like thickets, savanna, scattered shrubs covering another 2 to 3 per cent of the land area. The "series of vegetation" whose forest-cover is fast depleting deserve prime protection measures.

National Remote Sensing Agency (1983) has presented statistics of forest-cover state-wise according to the administrative divisions. The assessment according to the vegetation types or "series" has the advantage of identifying those series having negligible area under forests so that urgent steps could be provided for their conservation and restoration.

Key-words : Biodiversity, Conservation, Vegetation types, Forest percentages, Climatic complexities, Peninsular India.

INTRODUCTION

Multipurpose uses of Herbaria :

A herbarium is not merely a store-room containing dried plants. It is a record of collection of species of great reference value to taxonomists. Moreover it is a treasure house of invaluable geographic, ecological and evolutionary information of plants. The locality and date of collection are of significant historical and conservation value. These indicate whether a species is still available where it was growing a century or two ago and whether with the same abundance or not. The status could be discerned from the number of collections in the earlier period and now. Thus one has to have recourse to herbaria to learn about the shrinkage or expansion in the range of a species over a period of time.

Examples are not unknown of obscure species coming into prominence because of recent discovery of their economic utility or indicator property. The famous case is of the mosses, indicator of presence of copper in the soil. Reading the localities of copper mosses from herbaria led to the location of copper mines in Sweden.

Herbaria could also illuminate the evolutionary trends in the taxa with environmental implications. Study of population within a species could provide information as to a particular site is undergoing accentuation of aridity or not. Certain species exhibit a number of population, for e.g. the grass *Oropetium thomaeum* Linn. f. (Tandon, 1977). It may be possible to arrange these populations along a gradient of humidity-aridity. It could be an interesting exercise to compare the population of a particular site of Rajasthan or Sind with the herbarium specimens collected from the same locality a century or so ago and to note whether a trend towards xericity is indicated or not. Such an

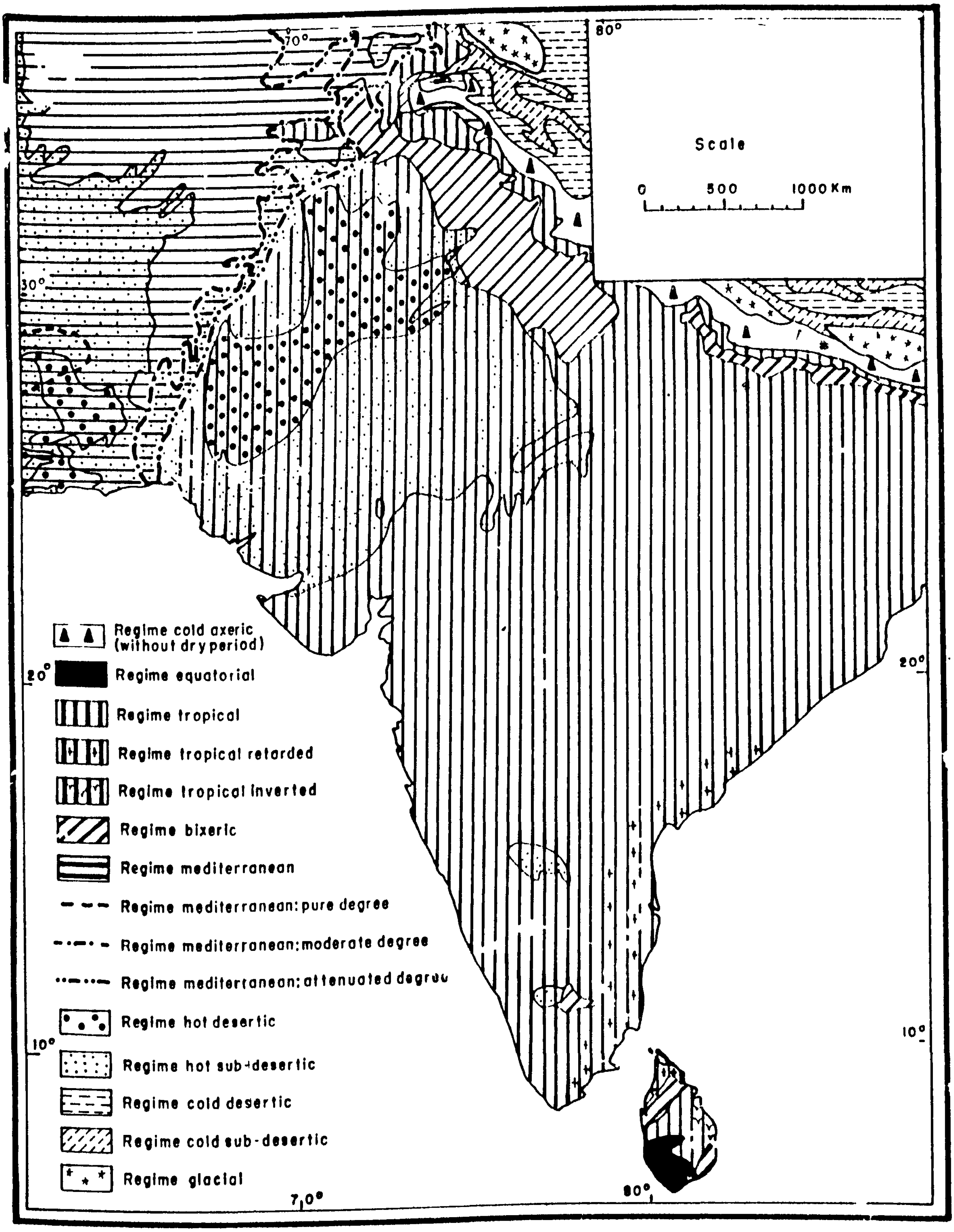
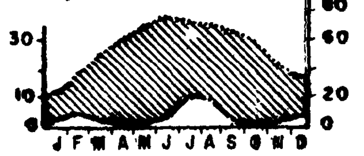


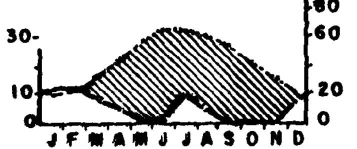
Fig. 1. Indian region: Main types of climatic regimes

Fig. 2 JACOBABAD



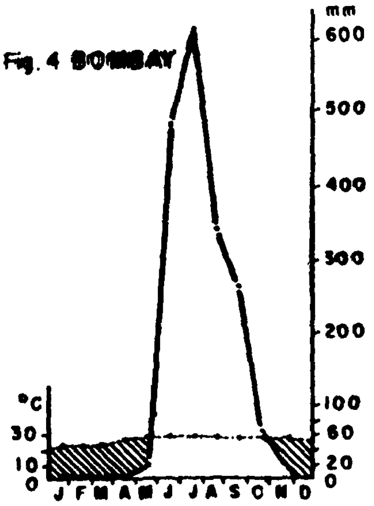
(Desertic - tropical tendency)

Fig. 3 PANJGUR



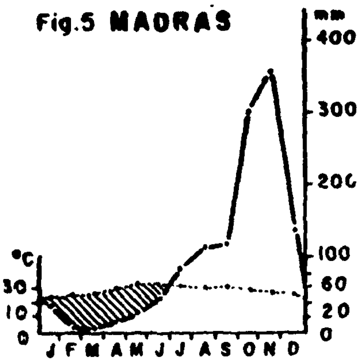
(Desertic - mediterranean tenden

Fig. 4 BOMBAY



(Tropical)

Fig. 5 MADRAS



(Tropical dissymetric)

Fig 6 QUETTA

(Mediterranean)

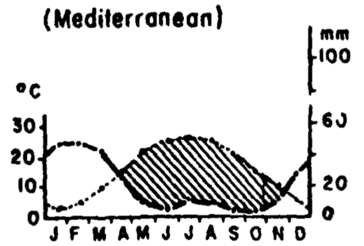
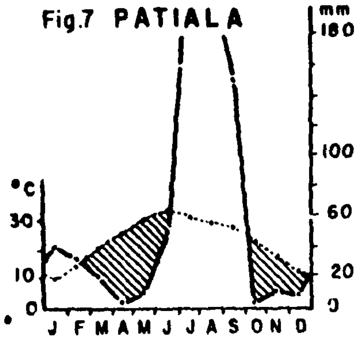
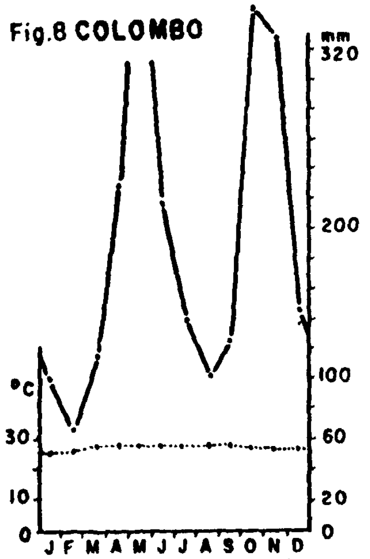


Fig. 7 PATIALA



(Bixeric)

Fig. 8 COLOMBO



(Axeric- Equatorial)

——— Rainfall curve

- - - - - Temperature curve

▨ Dry period

Figs. 2 – 8. Climate diagrams

investigation may give a clue to a biometeorological shift or stability in the degree of aridity.

Herbarium specimens of leaves of the tree *Palaquium grande* collected a century ago from the Deltota estate near Peradeniya, Sri Lanka show a lot of growth of curious algae-like moss *Ephemeropsis tjiboldensis,* which is a very good indicator of an ever moist micro-climate. However, a search of such epiphylous mosses in the same locality in recent years by Prof. W. Meijer of Kentucky University, U.S.A., proved futile because of the destruction of forests.

This is yet another instance of the value of herbarium as indicator of environmental change.

Properly maintained Herbaria have the advantage of being a permanent repository of plants. As against this, the plants in nature are subject to the vagaries of weather, climate, pests and a host of biotic pressures. Hence the present-day concern for the conservation of bio-diversity. In this direction the taxonomist plays a pioneering role in collecting, identifying and making a permanent record by way of building up a herbarium accompanied by copious notes on the distribution and habitat of the taxa.

Given the wealth of plant-diversity of over 21,000 species of higher plants in the Indian region, which is more than one tenth of the total number of species in the world, a first step towards their conservation is to classify them according to their habitat-types. A preliminary classification could be according to the vegetation types, Champion's (1936) classification was first such attempt which has dominated the Indian scene for over five decades. The classification based on "series of vegetation" (Gaussen, 1959) is the only other vegetation classification available for Peninsular India. Its advantages over Champion's classification have been enumerated by Meher-Homji (1978).

In order to understand the tremendous plant-diversity gifted by Mother Nature, a rapid look at the climatic and edaphic factors will not be out of place.

From climatic point of view, diversity may be examined from points of spatial and temporal variability in rainfall amount, length of distribution of the rainy season, the regime i.e. the season(s) of occurrence of rains and the temperature.

The climatic types vary from the equatorial type in the S.W. part of Sri Lanka with almost daily rainfall to the desertic type in W. Rajasthan and Sind with dryness of all the 12 months (Fig. 1). Between these two extremes, the climate ranges from dryness of 2-3 months in Southern Kerala to dryness of 11 months at the periphery of the Thar desert.

The desertic climate itself shows variations, from mediterranean type (whatever little rains that occur are in winter-spring) in the extreme west (e.g. Panjgur Fig. 2) to the tropical type (little rains in summer) in the eastern part of the Thar (e.g. Jacobabad Fig. 3).

The rainfall shows extreme spatial variations from over 1 m of rains in Cherrapunji in the east to less than 100 mm per annum for stations like Jacobabad in Pakistan, in the west, though both the regions are located almost on the same latitude.

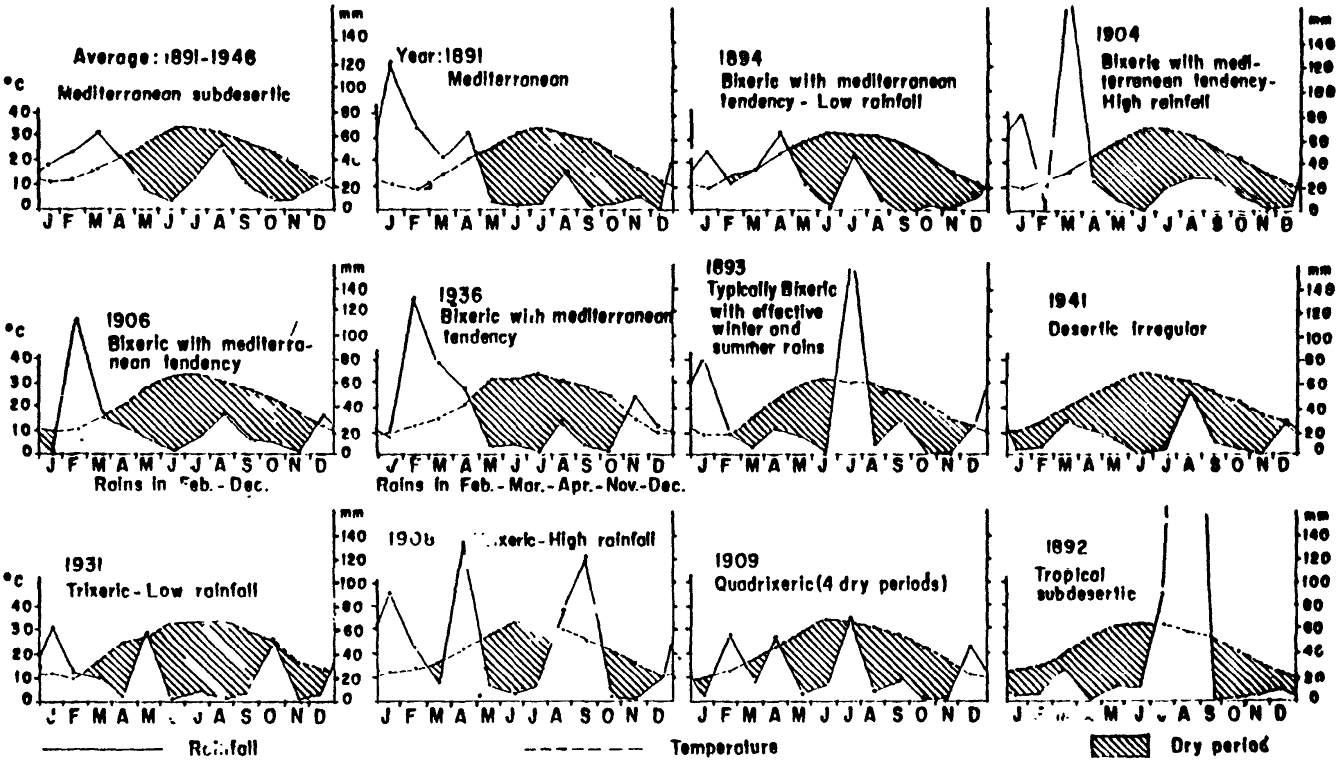
The seasons of occurrence of rains introduce yet another dimension of diversity. Though the major part of the Indian sub-continent is subject to tropical rains with summer rains due to the dominante of the South-West monsoon (Fig. 1), the northwestern parts in Afghanistan-Pakistan remain under Mediterranean regime with winter-spring precipitation. Likewise the Coromandel-Circar coastal tract receives bulk of rains in October-November from the so-called North-East monsoon wherein the depressions and cyclones formed in the Bay of Bengal are the principal sources of rains.

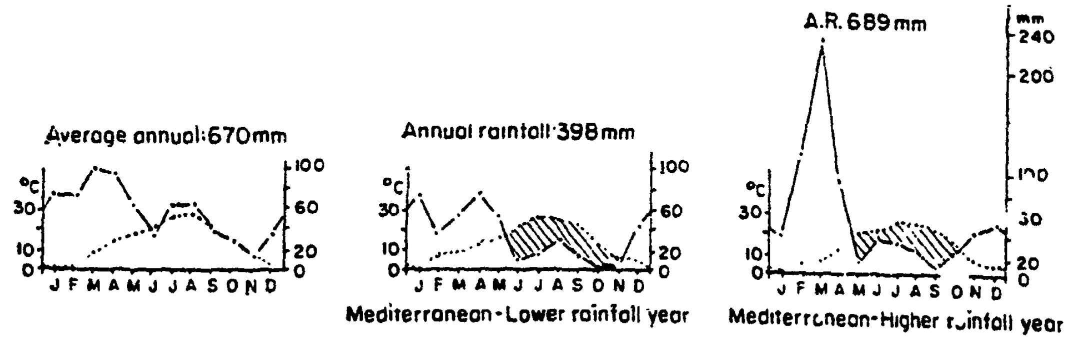
Fig. 4 of Bombay represents typical tropical regime with the rains beginning in June and terminating after September, with a peak in July. The rainfall curve thus maintains a symmetry in the course of the year. Fig. 5 of Madras is an example of dissymmetric regime. As the bulk of rains occur in October-November, the symmetry of the rainfall curve is lost. Mediterranean type of regime is illustrated by the climate diagram of Quetta in Fig. 6.

The situation is diametrically opposite to that of Bombay. Quetta experiences rains in winter-

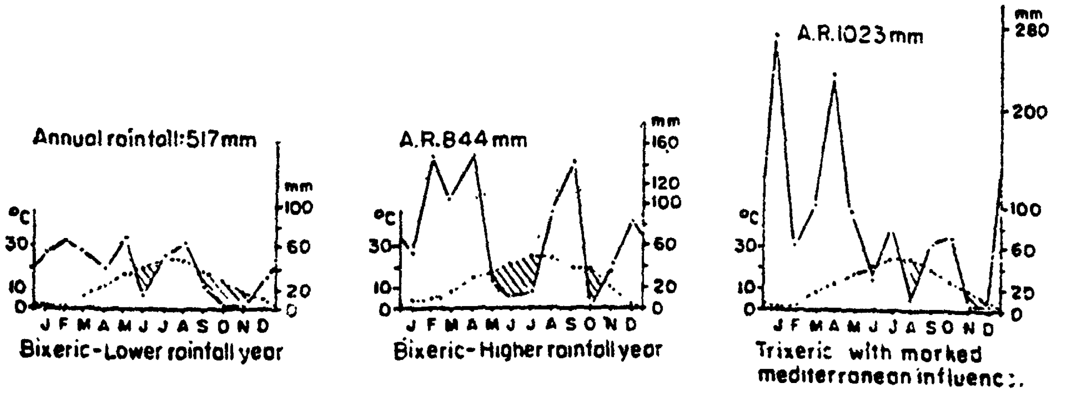
Fig. 9.

Interyearly variations in regime at Peshawar

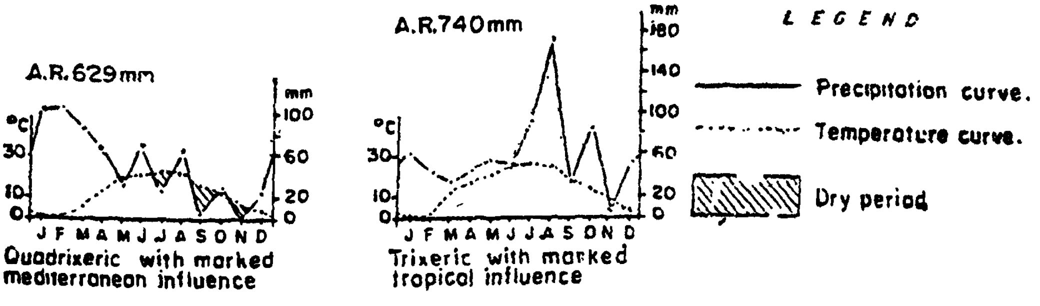




No.1. Average 1892-1963 No.2. Year 1934 No.3. Year 1936



No.4. Year 1927 No.5. Year 1928 No.6. Year 1930



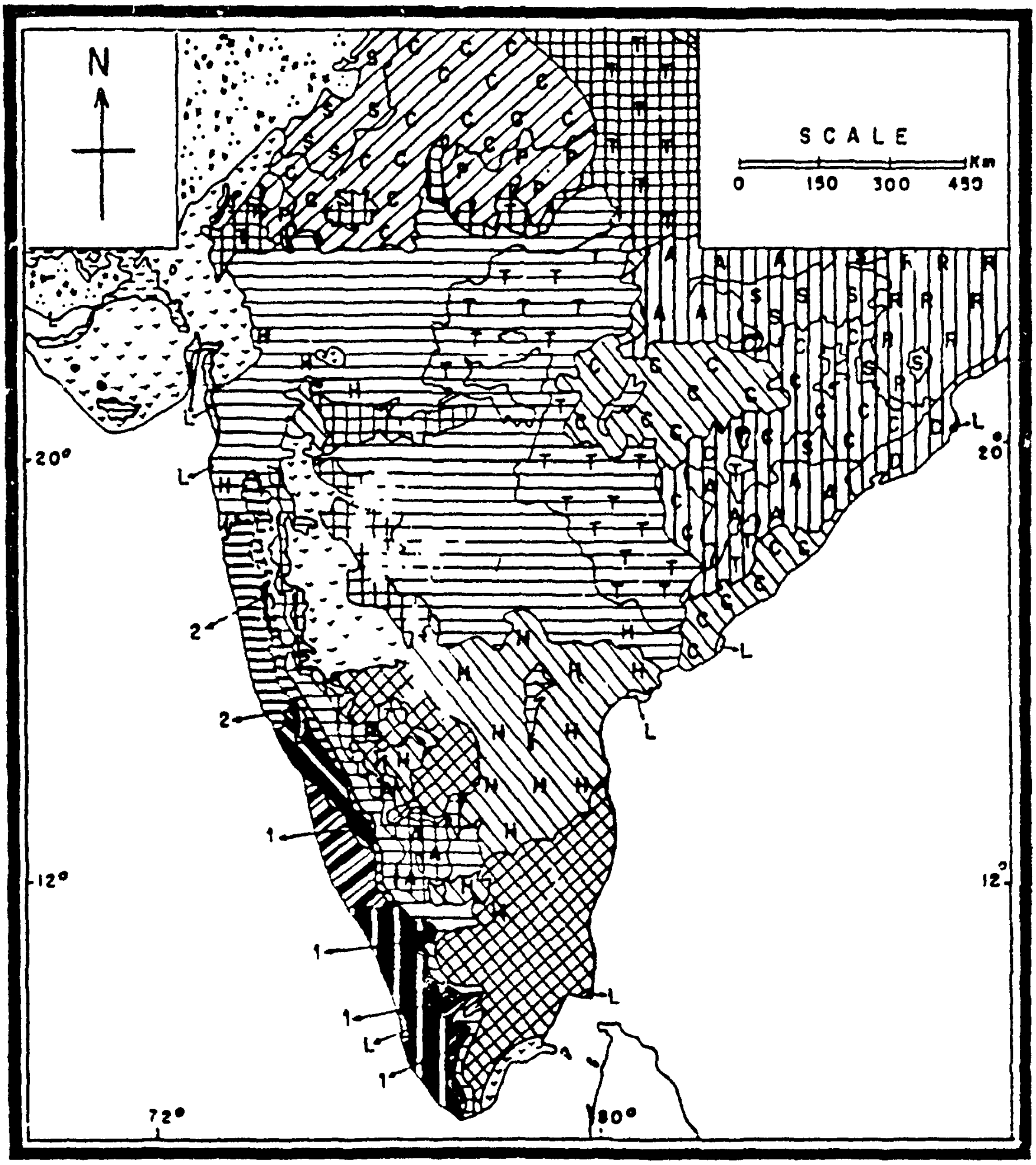
No.7. Year 1938 No.8. Year 1929

Fig. 10 Srinagar — Climate diagrams

spring under the influence of western disturbances; summer is dry in the absence of the S. W. monsoon.

The sub-Himalayan tract exemplified by the climate-diagram of Patiala (Fig. 7) has two rainy seasons, one in winter-spring on account of western disturbances and another in summer due to the S. W. monsoon with two dry periods separating the two rainy seasons. Hence the regime is called bixeric. Example of axeric regime without any dry period is that of the equatorial type of climate of the S. W. part of Sri Lanka (e.g. Colombo, Fig,. 8). There are two peaks of rainfall in April and October corresponding to the zenithal position of the sun and two lows of rainfall, so very typical of the climate on the equatorial latitude.

Fig. 11. Potential area of the major vegetation series



For the legend see Table I

The inter-yearly variability due to the vagaries of monsoon disrupts the above mentioned average pattern of climate. At some stations, the variations in the rainfall quantum from year to year may be so pronounced as to render the very definition of average climate almost meaningless. At Madras, the annual amount may be as low as 600 mm in one year, four times higher the next year. The average of 1250 mm is not often realised.

Similarly, there are glaring examples of variations in the length of the dry season. For example, at Kodaikanal, the majority of individual years experience a dry season of 1 to 3 months, but on the basis of averages of 60 or even 20 years, no month turns out to be dry. This happens because the dryness occurs in different months in different years. As a result, the dry spell lasting from 30 to 90 days, of real biological significance, disappears in the average data.

Yet in other cases, the fluctuations involve the regime, i.e. the season or seasons of occurrence of rains. For certain stations of Kashmir and Pakistan, the average regime turns out to be of Mediterranean type with winter-spring precipitation and summer dryness but in fact the regime varies from year to year as exemplified by the climate diagrams of Dera Ismail Khan, Peshawar and Srinagar (Kashmir) in Figs. 9 and 10. The individual years may not match the average pattern, nor do the individual years agree with each other.

From point of view of soils, 8 main types viz. skeletal, sandy, saline, alluvial, black, brown, ferruginous and ferrallitic have been recognised for Peninsular India in the insets of soils given on the vegetation maps prepared by the French Institute, Pondicherry in collaboration with the Indian Council of Agricultural Research (Gaussen *et al.* 1961a-1978). Altogether nearly 29 sub-types have been recognised within the 8 principal types.

Plant-diversity in Peninsular India :

The series of vegetation (Gaussen *et al.* 1961a-1978) recognised in peninsular India are enumerated in Table 1 and the potential areas of these series are indicated in Fig. 11. The series have been grouped under four main physiognomic types viz. thorny, deciduous, semi-evergreen, evergreen. According to Lieth (1975), the net primary productivity ranges from 2000 g/m^2/year in tropical evergreen rain forest to 600 in deciduous forest, 700 in savannas, 70 in thorny forest type and 3 in desert. Meher-Homji (1991) has compiled the number of species according to the series of vegetation. The species richness varies from 1700 to 2000 in the wet evergreen forest series of the Western Ghats to 700-850 in the deciduous forest series and 500 550 in the semi-arid to arid series and further within this frame work according to moisture status as arid, dry or wet.

In Table 2 is enumerated the percentage area under forest, open forest and other degraded vegetation in Peninsular India (including Andaman-Nicobar) at different periods according to various sources. According to recent estimates about 7 to 8% of the land area would be under forest cover (including open forests) and 2 to 3% would be under degraded vegetation i.e. thickets, savannas, scattered shrubs.

In Table I which serves as legend of Fig. 11 are also indicated the potential area under each series of vegetation, the percentage of this potential area under forest and under degraded vegetation according to the vegetation maps of Gaussen *et al.* (1961a-1978).

The largest potential area is under the dry deciduous teak forest type (53,340,000 ha), of which 36,090,000 ha are under *Terminalia-Anogeissus latifolia-Tectona* series and 17,250,000 ha under *Tactona-Terminalia* series. The thorny arid zone series of *Calligonum* and *Prosopis-Salvadora-Capparis-Ziziphus* types occupy potential area of 30,875,000 ha.

Table I reveals that the following "series" of the arid, semi-arid and dry zones of Peninsular India are practically without forests :

— *Calligonum*

— *Prosopis-Salvadora-Capparis-Ziziphus*

— *Acacia senegal-Anogeissus pendula*

— *Anogeissus pendul- Anogeissus latifolia*

—*Acacia-Anogeissus latifolia*

— *Manilkara-Chloroxylon*

— *Albizia amara-Chloroxylon-Anogeissus latifolia*

Table 1 – Series of vegetation of peninsular India and their classification

SERIES			CLASSIFICATION			
⬚	*Calligonum*	(30 875; – ; 5)	Arid			THORNY
⬚	*Prosopis* - *Salvadora* - *Capparis* - *Ziziphus*		Arid to semi-arid			
⬚	*Acacia* - *Capparis*	(17 250; –1; 3)				
▨ S	*Acacia senegal* - *Anogeissus pendula*	(3460; 1 ; 3)	Semi-arid	MISCELLANEOUS		DECIDUOUS
▨ C	*Acacia catechu* - *Anogeissus pendula*	(1580; 8; 3)				
▨ P	*Anogeissus pendula* - *Anogeissus latifolia* (with or without *Terminalia*)	(5000; 2 ; 3)	Dry			
▦	*Acacia* - *Anogeissus latifolia*	(9780; – ; 0.3)				
▧	*Anogeissus latifolia* - *Hardwickia binata*	(12 125; 12; 1)				
▦	*Anogeissus latifolia* *Terminalia*	(11 975; 6 ; 10)				
▧	*Terminalia* - *Anogeissus latifolia* - *Cleistanthus*	(10375; 8 ; 20)				
▤	*Terminalia* - *Anogeissus latifolia* - *Tectona*	(36090; 5 ; 14)	Dry	TEAK		
▤	*Tectona* - *Terminalia* - *Adina* - *Anogeissus latifolia*	(1625; 27; 10)	Intermediate			
▤	*Tectona* - *Terminalia*	(17 250; 15 ; 30)				
▤	*Tectona* - *Dillenia* - *Lagerstroemia* - *Terminalia paniculata*	(4975; 18; 7)	Moist			
▧	*Terminalia* - *Anogeissus* - *Cleistanthus*			TRANSITIONAL		
▥	*Shorea* - *Buchanania* - *Cleistanthus*	(8375; 14; 25)	Dry	SAL		
▥	*Shorea* - *Cleistanthus* - *Croton*	(10750; 7 ; 7)				
▥	*Shorea* - *Terminalia* - *Adina*	(19610; 37; 10)	Intermediate			
▥	*Shorea* - *Dillenia* - *Pterospermum*	(1875; 6 ; 3)	Moist			
▥	*Shorea* - *Syzygium operculatum* - *Toona* - *Symplocos*	(4950; 25; 42)			MONTANE	
▥	*Toona* - *Garuga*	(1000; 17; 17)	Moist			SEMI-EVERGREEN
◪	*Montane forest*	(500; 6 ; 19)		WET		EVERGREEN
◪	*Gordonia* - *Schefflera* - *Meliosma*					
◪	*Bridelia* - *Ficus glomerata* - *Syzygium*	(275; 41; 36)				
▧	*Memecylon* - *Actinodphe* - *Syzygium*	(500; 16; 18)				
■	*Machilus* - *Diospyros* - *Holigarna*	(1250; 52; –)				
▨	*Dipterocarpus* - *Mesua* - *Palaquium*	(1950; 26; 34)				
▮	*Cullenia* - *Mesua* - *Palaquium*	(2000; 15; 5)				
▩	*Acacia* - *Albizia amara*	(15350; 5 ; 1)	Dissymetric rainfall regime	DRY		
▩	*Manilkara* - *Chloroxylon*	(2750; 0.2; [illegible])				
▥	*Albizia amara* - *Chloroxylon* - *Anogeissus latifolia*	(2725; 05; 0-3)	Transitional Miscellaneous			

This table serves as a legend to Fig. II.

The figures in brackets after each series indicate respectively the potential area in each series in thousands of ha., the percentage of this area under forest and under degraded vegetation according to GAUSSEN *et al.* (1961a – 1978)

*Table 2. Percentage area under forest in Peninsular India for different periods according to various sources**

	French Institute-ICAR maps (Gaussen 1961a-1978) and Forest Atlas (Das Gupta, 1976)	National Remote Sensing Agency Report (1983, Table 3)		National Remote Sensing Agency (1983) Vegetation Maps, 1980-82 data with our interpretation	Forest Survey of India (1983)	Bellan (1985) (Revision of French Institute ICAR maps
		1972-75 data	1980-82 data			
Forest (Including *open forest*	7.2	10.9	8.8	8.0	7	7.8
Degraded vegetation (Thickets, savannas, scattered shrubs)	7.1			2.2	2.0	3.0

* Figures include Andaman-Nicobar Islands.

The following "series" have only 5 to 8 per cent of their potential area under forests.

— *Acacia-Albizia amara* series of Coromandel coast.

— *Acacia catechu-Anogeissus pendula* of the Aravallis.

— *Anogeissus latifolia-Terminalia* of M.P. Rajasthan border.

— *Terminalia Anogeissus latifolia, Cleistanthus* of Central India.

— *Terminalia-Anogeissus latifolia, Tectona* of the teak belt.

— *Shorea-Cleistanthus - Croton* of the Sal belt.

— *Shorea-Dillenia - Pterospermum* of the Sal belt.

— *Gordonia-Schefflera, Meliosma* of the Western Ghats.

The "series" with a relatively better percentage (25 and over) under forests are the evergreen types in the Western Ghats.

— *Machilus - Diospyros - Holigarna* (52%).

— *Bridelia Ficus glomeratus Syzygium* (41%).

— *Dipterocarpus - Mesua - Palaquium* (26%)

and

— deciduous *Shorea Terminalia Adina* (37%).

— deciduous *Shorea - Syzygium operculatu - Toona-Symplocos* (25%).

— deciduous *Tectona Terminalia - Adina Anogeissus latifolia* (27%).

The remaining series have their forest percentages ranging between 10 and 20 per cent. Conservation and restoration efforts should be concentrated for those "series" with low percentages of forests not only to protect the species diversity in them but also the vegetation types constituted by the mingling of the flora in diverse proportions.

REFERENCES

BELLAN, M. F. Eco-floristic maps of Peninsular India. L'Institute de la Carte Internationale du Tapis Vëgetal, Universitë de Toulouse, France. 1985.

CHAMPION, E. G. A preliminary survey of the forset types of India and Burma. *Indian For. Rec. (n.s.)* Silva 1(1). 1936.

DAS GUPTA, S. P. (Ed). Forest Atlas of India. Nat. Atlas Organisation, Calcutta. 1976.

FOREST SURVEY OF INDIA NATIONAL VEGETATION MAP PROJECT. Dept. of Environment, Forests & Wildlife, New Delhi. 1985.

GAUSSEN, H. The vegetation maps. Inst. Fr. Pondichery. Trav. Sect. Sci. Tech. 1(4) : 155-180. 1959.

——— P. LEGRIS, M. VIART, V. M. MEHER-HOMJI. Sheet Cape Comorin. In International map of vegetation and environmental conditions. ICAR, New Delhi and Ibid. Hors Serie No. 1. 1961a.

GAUSEN, H., P. LEGRI, M. VIRAT, V. M. MEHER-HEMJI. Sheet Madras. Ibid. Hors Serie No. 2. 1961b.

——— Sheet Godavari. Ibid. Hors Serie No. 3. 1963a.

——— Sheet Jagannath. Ibid. Hors Serie No. 4. 1963b.

——— Sheet Mysore. Ibid. Hors Serie No. 7. 1965a.

——— Sheet Bombay. Ibid. Hors Serie No. 8. 1965b.

——— Sheet Kathiawar. Ibid. Hors Serie No. 9. 1968a.

——— Sheet Satpura Mts. Ibid. Hors Serie No 10. 1968b.

———, V. M. MEHER-HOMJI, P. LEGRIS, F. BLASCO, A. DELACOURT, R. K. GUPTA AND J.P. TROY Sheet Rajasthan. *Ibid*. Hors Serie No. 12. 1971.

———, P. LEGRIS. F. BLASCO. V. M. MEHER-HOMJI AND J. P. TROY. Sheet Wainganga. *Ibid*. Hors Serie No. 13. 1972.

——— , Sheet Orissa. *Ibid*.. Hors Serie No. 14. 1973.

———, V. M. MEHER-HOMJI, J. FONTANEL. P. LEGRIS AND J. P. PASCAL. Sheet Allahabad, *Ibid*. Hors Seris No. 15. 1978.

LIETH, H. Primary production of the major vegetation unito of the world, pp. 203-215. In : Lieth, H. (Ed.). Primary Productivity of the Biosphere. Springer-Vorlag, Berlin. 1975.

MEHER-HOMJI, V. M. Vegetation classification : Need we dissociate environmental terminologies from the physiognomic nomenclature? *Indian For.* 104(10) : 653-660. 1978.

——— Changes in phytomass cover in relation to hydrological cycle, pp. 234-258. In : Khoshoo, T. N. and Sharma, Manjula (Eds.). Indian Geosphere-Biosphere. National Academy of Sciences, India. 1991.

NATIONAL REMOTE SENSING AGENCY. Nation-wide mapping of forest and non-forest areas using Landsat false colour composites for the periods 1972-1975 and 1980-1982. Project Report Vol. 1. Nat. Remote Sensing Agency. Hyderabad. 1983.

TANDON, R. K. Ecological investigations on *Oropetium thomaeum* (Linn. f.) Trin. Ph. D. Thesis, Delhi Univ. Delhi. 1977.